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Enclosure A Training Program on Internal Combustion Engines

Training Purpose: To study the general structure of internal combustion engines, and to give soldiers the initial practice for work with them.

Methods of Instructions

Training should be given by officers who are well acquainted with internal combustion engines, aided by engine mechanics picked out of the ranks of soldiers with long periods of service. Training should be given in technical classes, equipped with cross sections of motors, parts and details of engines, and charts. Simultaneously training should also be given in garages utilizing models of standard engines and mechanical appliances.

Subject #2 must be studied prior to lesson 9, subject #1. To obtain practical experience, work on internal combustion engines should be carried out during specially organized practical exercises as well as during other training periods on engines.

Study of internal combustion engines must be planned in the beginning of the second phase in order to enable assigned engine mechanics to improve themselves in the future by means of special training.

Subject #1. The Internal Combustion Engine

Lesson 1. General Information on Engines

Employment of internal combustion engines. Classification of engines. Basic mechanics and systems of engines (crank gear, distributor system, cooling system, lubricating system, fuel and ignition system) and their purpose.

Lesson 2. The Principle of Engine Function

The working process of a single cylinder, four-cycle engine (intake, compression, combustion and exhaust). The meaning of each cycle. Piston stroke. The direction of the piston stroke and the position of the valves. Dead points.

Purpose of the flywheel. Shortcomings of a single cylinder engine. Multiple cylinder engines. Two-cycle diesel engines.

Lesson 3. Cylinders, Pistons, Connecting Rods

General information on the crankgear. Cylinder and cylinder block. Basic parts of a cylinder. The piston and its basic parts. The maximum and the working capacity of cylinders. Combustion chamber. Degree of compression. Piston rings (compression rings and removable oil rings). Connecting rods and their basic parts. Connection between the connecting rod and the piston.

Lesson 4. Crankshafts, Flywheels and Crank Cases (Housings)

The crankshaft and its basic parts. The shape of the crankshafts of one-cylinder, two-cylinder, four-cylinder and six-cylinder engines. Counter balances. Flywheel. Engine crank case. Main bearings and fastening of the crankshaft. Coordinated interaction of parts in the crankgear. The running process in four cycle four-cylinder and six-cylinder engines.

Lesson 5. The Fuel Distributing Mechanism

Parts [illegible] of the fuel distributing mechanism, their purpose, structure and interaction. Charts on the operation of the disbributing mechanism at the lower and upper valves.

Lesson 6. Adjustment of the Distributing Mechanism

Diagrams of fuel distribution (phases of distribution) in the two and four- cycle engines. Explanation of advanced and retarded opening and closing of valves. Installation of the distributing mechanism. Adjustment of clearance in valves.

Lesson 7. Cooling of Engine

Necessity of cooling the engine. Results of overheating or overcooling of engine. Air cooling. Water cooling with thermosiphon circulation. Compulsory (forced) and mixed cooling. Parts of the cooling system under different temperature conditions. The use of low temperature freezing fluids and antifreezes. Defects in the cooling systems.

Lesson 8. Lubricants and Types of Lubrication

Significance of lubrication of moving parts of the engine. Basic types of lubricating oils used for engine lubrication and their characteristics. The system of lubrication by spraying lubrication, under pressure and the two combined. Requirements for the quality of oil for running an engine under different temperature conditions. The oil pump and its priming. Oil lines. Filters for fine and coarse filtration. Reduction valve. Pressure gauge. Arrangement and operation of parts of the lubricating system. Lubricating standards. Maintenance of the lubricating system.

Lesson 9. Composition of Fuel and Carburetion

General information on fuel and its preparation. Composition of the fuel mixture (normal, diluted, lean, enriched and rich). Process of carburetion. Fuel requirements for varying work cycles of the engine. Elementary jet carburetor. Carburetor parts, their purpose (function) and arrangement. The preparation of fuel by the elementary carburetor. Shortcomings of the elementary carburetor.

Lesson 10. Arrangement of the Carburetor

Carburetor parts, their arrangement and function. Adjustment of carburetors. Deficiencies in carburetor function. The elimination of deficiencies.

Lesson 11. Arrangement and Function of the Fuel Feed Syste-

Chart of gravity feed and of feed with the help of a diaphragm pump. Arrangement and function of diaphragm pumps. Arrangement of air filters. Suction tubes and exhaust collectors. Mufflers. Elimination of deficiencies in the fuel system.

Lesson 12. General information on the Use of the Electric Current in an Engine

Instruction on the ignition system. The use of the electric current in the engine. General instruction on the electric current. Generation of the electric current. The sources and the users of the electric current in the engine. Internal and external circuits. Acquaintance with the arrangement of the battery and the direct current generator. (Dynamo).

Lesson 13. The Arrangement and the Function of the Battery-Fed Ignition

Parts of the battery-fed ignition, their functions and arrangement. Ignition chart. Current circuits of low and high voltage. Advanced ignition and the timing of the ignition system. The dependency of the angle of advanced ignition to the number of rotations of the crankshaft and the stress on the engine.

Lesson 14. The Arrangement and Function of the Ignition System from the Magneto and the Arrangement of the Starter

The working principle of the magneto. The magneto with a revolving magnet. Basic parts, their functions, arrangement and interaction. Magneto drive. Timing of the ignition by the magneto. Magneto maintenance. Current circuits. Understanding current consumption. Details of the starter, its function and arrangement. Regulations governing the use of the starter.

Subject #2. Fuel for the Engine and its Combustion

Types of fuels used for engines (light and heavy). Gasoline as the basic type of fuel for carburetor engines. External distinguishing characteristics of gasoline and its properties. Straight distillation gasoline and "cracked" gasoline. Ethylation of gasoline. Fuel for diesel engines - gas oil, solar oil, diesel fuel (summer and winter). The process of fuel combustion. Inclination to detonation. Understanding the octane rating.

Subject #3. General Rules for Work with Internal Combustion Engines

Lesson 1. Preparation of the Engine for Work and Starting it

Inspection of the engine. Checking of the cooling and lubricating systems. The starting and warming up of the engine. Determining the fuel quality according to the external criteria of the running engine. Operation of the engine. Stopping the engine.

Lesson 2. The Adjustment of Carburetors and the Elimination of Deficiencies in Them

The adjustment of the carburetor for a small number of revolutions in an idling engine. The adjustment of the accelerator pump. Stopping the engine.

The elimination of basic deficiencies in a carburator: obstruction in filters, jet nozzles, intake of impure air, fuel leakage in the needle valve, fuel flow. Cleaning of the sedimentation tank and air filters.

Lesson 3. The Adjustment and Maintenance of the Ignition System

The adjustment of the ignition from the battery or ignition from a magneto of high voltage. Maintenance and adjustment of the ignition. Elimination of deficiencies. Determining the charge of a battery. The wiring system. The checking of the condition of the brushes and the manifold, cleaning of the manifold. The adjustment of the charging current by means of the third brush of the generator. The fastening of the wires. Cleaning the points in the distributor and the adjustment of the explosive force. Checking the presence of a current in the circuits of high and low voltage. Checking the condition of the condenser and its replacement. Checking for non functioning spark plugs.